

Liming

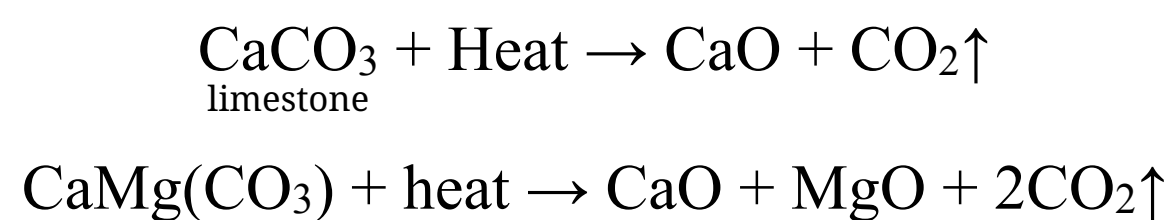
Liming: The addition of lime to acidic soil to rise their p^H to encourage favourable condition or nutrient availability and to increase microbial activity. This neutralize soil acidity. However, over supply may result in harm to plant life. Lime is a basic chemical.

Liming Materials: An agricultural liming material containing Ca and Mg compounds capable of neutralizing soil acidity.

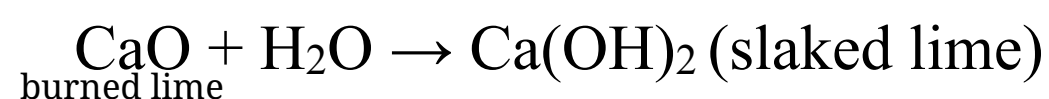
OR, The materials which are used for neutralizing of acidic soil.

Classification of Liming Material

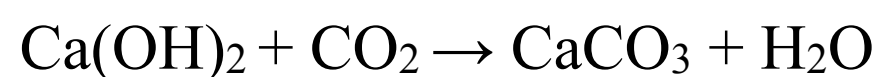
i. Oxides of lime: It is normally called burned lime or quick lime. Oxide of lime is more caustic than limestones. Burned lime is produced by heating limestone and dolomite as follows-



ii. Hydroxides of lime: It can be produced by adding water to burned lime & is called *Slaked lime*.



It is more caustic than burned lime (CaO). If it is kept open in the moist air, then combination of Calcium Hydroxide occurs as follows-



iii. Carbonates of lime: These are by-products of certain industries and so the content of Calcium and Magnesium varies. The 2 important minerals are found in this group-



iv. Slags: These are generally 3 types of slags that are found important -

a) Blast furnace slag- It is a by-products of Pig iron. As a liming material, this Slags behaves essentially as Calcium Silicate. The neutralizing value of blast furnace slags ranges about from 75-90%.

b) Basic slag- It is a by-products of open-hearth method of making steel from pig iron. The impurities in the iron, including Silica and Phosphorus are fluxed with lime and basic slag are produced. It's neutralizing value ranges from 60-70%.

c) Electric furnace slag- This is produced from the electric furnace reduction of phosphate rock during preparation of elemental Phosphorus. This products is largely Calcium Silicate and is use as a liming material.

v. Other Liming Material: Coral shell, chalk, wood ash, press mud, by-products material of paper mills, sugar factories, ash and sludge etc are considered is liming materials and also used for the amelioration of

soil acidity.

Methods of Application of Liming Materials

- The application of small amounts of lime of soil in every year or twice in a year has been found to be most effective. But it involves the application cost of the liming material.
- Generally lime should be applied well ahead of the crop cultivation and broadcasted limes are to be well mixed with the whole plough layer soil so that liming reaction can occur in a faster rate.
- The usual liming practice consists of a compromise between what is most effective and what is Cheapest/ ton of lime applied.
- When both surface and sub-surface soils are strongly acidic e.g. ultisols, it sometimes pays to incorporate lime to a depth of about 30 cm.
- Application of no till fields soil may not be as effective as application to an equivalent cultivated soil

Factors Affecting Liming Reaction

Moisture: The greater amount of moisture, the more rapid is the rate of reaction. Obviously, moisture must be present before the solubility reaction can occur. As moisture increases, the degree of aeration is reduced resulting an increase in the concentration of CO₂ in the soil air and thereby increases the rate of reaction. Since the reaction is an equilibrium reaction, the accumulation of end products would reduce reaction rate over time.

Temperature: Lime and liming materials react more rapidly at high than at *low temperatures*. This effect is probably related to diffusion rates of end products away from the reaction sites.

Amount of Exchange Acidity: Amount of Exchange Acidity present in the soil affects reaction rate. If a soil has a high lime requirement and if a sufficient quantity of limestone is added to neutralize the acidity present, the initial reaction will be quite rapid. However, as the acidity becomes neutralized the rate of reaction decreases and finally, as neutrality is approached become almost negligible.

Effect of over Liming

When excessively large amount of lime applied to an acidic soil the growth of plants is affected by influencing either one or many these following causes-

1. Deficiency of Iron (Fe), Copper (Cu) and Zinc (Zn) will occur.
2. Phosphorus (P) and Potassium (K) availability will be reduced.
3. Due to high OH⁻ concentration by over liming, root development will be inhibited in association with tip swelling brought about by hydrations. Due to dehydrating properties of Boron, it act as a protective agent for excess OH ion concentration.
4. Due to over liming Boron (B) deficiency will occur.
5. Due to application of lime in excess, the incidence of disease like *scab in root crops* will be increased.

All these can be reduced with the application of large amounts of organic manures like rotten farm yard manure, green manure crops, compost etc to the soil.

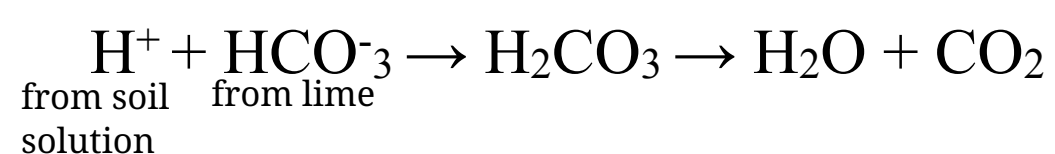
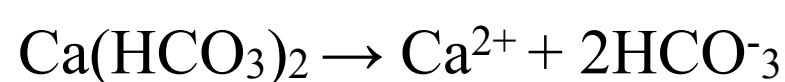
Lime Balanced Sheet

When a soil had its acidity corrected by lime, how often must lime be added and how much is needed to keep the soil P^H suitable. Lime is neutralized or lost from the soil by 6 activities-

- i. Neutralization by acid forming fertilizer, *a rapid change*.
- ii. Neutralization by the acid formed by CO_2 in water, *a slow process*.
- iii. Leaching *a relatively slow change*.
- iv. Removal in harvested or grazed crops, *relatively slow loss*.
- v. Erosion a top soil is lost with its higher base saturation and often leaving more acidic sub-soil to be limed.
- vi. Neutralization by acids dissolved in precipitation, resulting from oxides of Sulphur fumes from manufacturing plants, *a slow process*.

Principles of Liming Reaction

Lime reactions in soil depends, upon the nature and the fineness of the liming materials. Lime is usually applied to soils in the form of grouped limestone. Limestones can be classified as Calcite ($CaCO_3$), dolomite [$CaMg(CO_3)_2$] or a mixture of two. Both of them limestone are sparingly soluble in pure water but do become soluble in water containing CO_2 . The greater the partial pressure of CO_2 in the system, the more soluble the limestone becomes. Dolomite is somewhat less soluble than Calcite. The reaction of limestone can be written-



In this way, H^+ ion in the soil solution react to form weakly dissociated water and Calcium (Ca^{2+}) ion from limestone is left to undergo cation exchange reactions. The acidity of the soil is, therefore neutralized and the percent base saturation of colloidal material is increased.

Role of Lime on Soil Properties

The changes of lime in the soil are many and more complicated. The benefits of lime on the plant growth may be direct and indirect.

Direct benefits

- Toxicity of Al and Mn is the most important growth limiting factor in many acid soil and this toxicity effect can be reduced by the application of liming materials.
- H^+ toxicity can be removed through lime application.

Indirect benefits

1. **Phosphorus availability-** At low p^H values and on soils high in Al and Fe phosphates are rendered less available because of their reaction with these compound. The application of liming materials to such

soils will inactive the Fe and Al, thus increasing the level of plant available phosphorus.

2. **Micro-nutrient availability-** Fe, Mn, Cu, Zn, Mo and Boron with the exception of Mo the availability of Micro-nutrients increases with a decrease of soil p^H . The toxic effects of most of the micronutrient due to high concentration can be prevented by the application of lime.
3. **Nitrification-** Nitrification is enhanced by liming to a p^H of 5.5 - 6.5, since the conversion of ammonia to nitrate requires large amount of active Ca decomposition of organic matter and other plant residue can also be improved with the application of lime by increasing the activity of micro-organisms.
4. **Nitrogen fixation-** The process of nitrogen fixation both symbiotic and non-symbiotic is favoured by liming.
5. **Soil physical condition-** The structure of fine textured soil may be improved by liming through increasing the organic matter and flocculation of Ca saturated soil. Liming decrease the bulk density of soil, increases infiltration and percolation rates of water and checks soil erosion.
6. **Disease-** Club rot disease of cole crops can be reduced with the application of lime.
7. **Efficiency of fertilizer-** Liming increases the efficiency of different fertilizers specially nitrogenous and phosphatic fertilizer by modifying the soil reaction favourably.